CONTENTS

	Page
Phoma Destructiva, the Cause of a Fruit Rot of the Tomato. CLARA O. JAMIESON	1
Availability of the Nitrogen in Pacific Coast Kelps. GUY R. STEWART	21
Organic Constituents of Pacific Coast Kelps. D. R. HOAGLAND	39
Sources of the Early Infections of Apple Bitter-Rot. JOHN W. ROBERTS	59
A Bacteriological Study of Methods for the Disinfection of Hides Infected with Anthrax Spores. F. W. TILLEY	65
Observations on Rhizina Inflata. JAMES R. WEIR	93
Pseudomonas Citri, the Cause of Citrus Canker. CLARA H. HASSE	97
Wilt of Gipsy-Moth Caterpillars. R. W. GLASER	101
Effect of Temperature on Germination and Growth of the Common Potato-Scab Organism. MICHAEL SHAPOVALOV	129
Seedling Diseases of Sugar Beets and Their Relation to Root-Rot and Crown-Rot. H. A. EDSON	135
Phoma Betae on the Leaves of the Sugar Beet. VENUS W. POOL and M. B. MCKAY	169
Notes on the Hydrocyanic-Acid Content of Sorghum. J. J. WILLAMAN and R. M. WEST	179
Effect on Soil Moisture of Changes in the Surface Tension of the Soil Solution Brought About by the Addition of Soluble Salts. P. E. KARRAKER	187
Relation Between Puccinia Graminis and Plants Highly Resistant to Its Attack. E. C. STAKMAN	193
Antagonism Between Anions as Affecting Barley Yields on a Clay-Adobe Soil. CHARLES B. LIPMAN and W. F. GERICKE	201
A New Wheat Thrips. E. O. G. KELLY	219
Cytological Studies of Azotobacter Chroococcum. AUGUSTO BONAZZI	225
Influence of Soil Moisture upon the Rate of Increase in Sugar-Beet Root-Louse Colonies. J. R. PARKER	241
A New Leaf and Twig Disease of Picea Engelmanni. JAMES R. WEIR	251
Some Sugar-Cane Root-Boring Weevils of the West Indies. W. DWIGHT PIERCE	255

Page

A Contribution to the Life History of Spongospora Subterranea. L. O. KUNKEL 265

Rheosporangium Aphanidermatum, a New Genus and Species of Fungus Parasitic on Sugar Beets and Radishes. H. A. EDSON .. 279

Heredity of Color in Phlox Drummondii. ARTHUR W. GILBERT .. 293

Asparagus-Beetle Egg Parasite. F. A. JOHNSTON 303

Inheritance of Certain Characters of Grapes. U. P. HEDRICK and R. D. ANTHONY 315

Ascochyta Clematidina, the Cause of Stem-Rot and Leaf-Spot of Clematis. W. O. GLOYER 331

Methods of Bacterial Analyses of Air. G. L. A. RUEHLE 343

Wallrothiella Arceuthobii. JAMES R. WEIR 369

Tensile Strength and Elasticity of Wool. ROBERT F. MILLER and WILLIAM D. TALLMAN 379

Influence of Hybridization and Cross-Pollination on the Water Requirement of Plants. LYMAN J. BRIGGS and H. L. SHANTZ .. 391

Further Studies of the Embryology of Toxoptera Graminum. W. J. PHILLIPS 403

Prickly-Pears as a Feed for Dairy Cows. T. E. WOODWARD, W. F. TURNER, and DAVID GRIFFITHS 405

A Nasturtium Wilt Caused by Bacterium Solanacearum. MARY K. BRYAN 451

Phosphorus Metabolism of Lambs Fed a Ration of Alfalfa Hay, Corn, and Linseed Meal. E. L. ROSS, M. H. KEITH, and H. S. GRINDLEY 459

A Bacterial Disease of Lettuce. NELLIE A. BROWN 475

Degree of Resemblance of Parents and Offspring with Respect to Birth as Twins for Registered Shropshire Sheep. H. L. RIETZ and ELMER ROBERTS 479

Soil Protozoa. GEORGE P. KOCH 511

Tylenchus Similis, the Cause of a Root Disease of Sugar Cane and Banana. N. A. COBB 561

Index 569

ERRATA

Page 108, footnote, "no. 1, p. 1–25, 1 fig." should read "no. 1, p. 1–25, 1912."

Page 111, line 7 from bottom, "Protein bodies stain," etc., should read "These so-called protein bodies stain," etc.

Page 172, Table I, last column, line 13, "9" should read "0."

Page 230, line 12, "methylene violet and with eosin" should read "methylene violet with eosin."

Page 234, line 6, "indicating presence of a reagent" should read "indicating the presence of the reagent."

Page 279 "*Rheosporangium aphanidermatus*" should read "*Rheosporangium aphanidermatum*.

Page 291, line 7, "*Rheosporangium aphanidermatus* n. sp." should read "*Rheosporangium aphanidermatum*, n. sp."

Page 306, line 2 from bottom, "which were treated as noted before" should read "which were treated as hereafter noted."

Page 344, line 10, "as indicated under 1" should read "as indicated under a."

Page 368, line 2 from bottom, "A new method of enumerating bacteria" should read "A new method of enumerating bacteria in air."

Page 455, legend under figure 3, "center" should read "outer."

Page 477, line 18 from top, "It is Gram-positive" should read "It is Gram-negative."

Page 477, line 23 from top, "*Bacillus lactuacae*" should read "*Bacillus lactucae*."

ILLUSTRATIONS

PLATES

PHOMA DESTRUCTIVA, THE CAUSE OF A FRUIT ROT OF THE TOMATO

Page

PLATE A (colored). Tomato fruit spotted with *Phoma destructiva:* Fig. 1.—Natural infection on tomato received from Cutler, Fla., March, 1912. Fig. 2, 3, 4, and 5.—Spots produced as the result of needle-prick inoculations with *Phoma destructiva*..... 20

PLATE B (colored). Potato and tomato leaflets spotted as result of inoculation with *Phoma destructiva:* Fig. 1.—Potato leaflet from sprayed plant. Fig. 2 and 3.—Tomato leaflets from sprayed plant..... 20

PLATE I. Fig. 1.—*Phoma destructiva:* Group of pycnidia, with surrounding mycelium, showing relation of the parasite to the host tissue. *P*, Pycnidia; *M*, mycelium; *C*, cell of host. Fig. 2.—*Phoma destructiva:* Single hyphæ, showing septation and branching. Fig. 3.—*Phoma destructiva:* A few pycnospores highly magnified. Fig. 4.—*Phoma destructiva:* Pycnidium and surrounding mycelium. Fig. 5.—*Phoma destructiva:* Pycnidium as seen in cross section of diseased tissue of tomato fruit. Fig. 6.—*Phoma destructiva:* Pycnidium from artificial culture. Fig. 7.—*Phoma destructiva:* Pycnidium and surrounding mycelium..... 20

PLATE II. Mature and young tomato plants grown in greenhouse, showing infection by *Phoma destructiva:* Fig. 1 and 2.—Mature plants. Fig. 1.—Control plant. Fig. 2.—Diseased plant, 10 days after spraying with a spore suspension of *Phoma destructiva*. Fig. 3 and 4.—Young plants with foliage spotted as a result of inoculation with *Phoma destructiva*..... 20

PLATE III. Fig. 1.—*Phoma destructiva:* Natural infection on tomato fruit received from Cuba. Fig. 2.—*Phoma destructiva:* One tomato fruit on vine diseased by needle-prick inoculation..... 20

PLATE IV. Tomato leaves showing spots produced by spraying with a suspension of *Phoma destructiva*..... 20

PLATE V. Potato leaves affected with spots produced by spraying with a suspension of *Phoma destructiva*..... 20

PLATE VI. *Phoma destructiva:* Artificial cultures. Fig. 1.—Test tube cultures. *a*, Melilotus stem; *b*, string-bean agar; *c*, potato slant. Fig. 2.—Corn-meal flask culture..... 20

SOURCES OF THE EARLY INFECTIONS OF APPLE BITTER-ROT

PLATE VII. Fig. 1.—Givens apple having numerous small blister-like infections of bitter-rot. Fig. 2.—Bitter-rot canker from a Jonathan apple tree. Fig. 3.—Part of a branch of a Givens apple tree which had been injured, probably by freezing. Fig. 4.—Apple branch showing blighted area on which acervuli of the bitter-rot fungus were found. Fig. 5.—Mechanically injured branch of a Missouri Pippin apple tree. Fig. 6.—Branch of Missouri Pippin apple tree affected with apple-blotch..... 64

OBSERVATIONS ON RHIZINA INFLATA

PLATE VIII. Fig. 1.—Mature fruiting structure of *Rhizina inflata*, showing the undulating upper surface. Fig. 2.—Immature fruiting structure of *Rhizina inflata*. Fig. 3.—Fruiting structure of *Rhizina inflata*, showing the peculiar mycelial strands or fibrils by which the fruiting body is attached to the substratum..... 96

PSEUDOMONAS CITRI, THE CAUSE OF CITRUS CANKER

Page

PLATE IX. *Pseudomonas citri:* Fig. 1.—Drawing of a stained section of a portion of a grapefruit leaf bearing a young canker resulting from inoculation with a pure culture of *P. citri.* Fig. 2.—Photomicrograph of *P. citri* stained by the Williams method for flagella. Fig. 3.—Top view of a grapefruit seedling showing the results of artificial inoculation with *P. citri* isolated from Texas specimens. Fig. 4.—View of the lower side of the leaves shown in figure 3. Fig. 5.—Top view of a grapefruit seedling showing the results of inoculation with *P. citri* obtained from Florida specimens. Fig. 6.—View of the lower side of the leaves shown in figure 5 100

PLATE X. *Pseudomonas citri:* Small lesions on Citrus twigs and more obvious cankers on Citrus leaves. *A*, Cankers on twig and leaves from Florida produced by natural infection; *B*, natural infections on leaves from Texas, *C*, cankers on twig and leaves produced by artificial inoculation 100

WILT OF GIPSY-MOTH CATERPILLARS

PLATE XI. "Wilted" gipsy-moth caterpillars hanging to a tree trunk 128

PLATE XII. Fig. 1.—Photomicrograph of a smear from a "wilted" gipsy-moth caterpillar. Fig. 2.—Photomicrograph of polyhedra clustering around a tracheal tube of a gipsy-moth caterpillar. Fig. 3.—Photomicrograph showing various stages during the formation of polyhedra in tissue nuclei of a gipsy-moth caterpillar 128

PLATE XIII. Fig. 1.—A silkworm polyhedron, after Prowazek. Fig. 2.—Two gipsy-moth caterpillar polyhedra adhering to each other. Fig. 3 to 10.—Polyhedra of gipsy-moth caterpillar cracking to pieces. Fig. 11 to 18.—Urate crystals of a gipsy-moth caterpillar. Fig. 19.—Polyhedron of a gipsy-moth caterpillar stained, showing a dark central mass. Fig. 20.—Polyhedron of a gipsy-moth caterpillar stained, showing refractive granules. Fig. 21.—Chromatin lump in middle of pathological nucleus of a gipsy-moth caterpillar. Fig. 22.—Iron hæmatoxylin showing stained polyhedra of a gipsy-moth caterpillar in a nucleus. Fig. 23.—Giemsa's stain, showing unstained polyhedra of a gipsy-moth caterpillar in a nucleus and little granules. Fig. 24.—Fully formed polyhedra of a gipsy-moth caterpillar in a nucleus. Fig. 25.—Nuclear membrane rupturing and allowing polyhedra of a gipsy-moth caterpillar to escape 128

PLATE XIV. Fig. 1 and 2.—Normal blood corpuscles of the gipsy-moth caterpillar. Fig. 3 and 4.—"Mulberry" corpuscles of the gipsy-moth caterpillar. Fig. 5.—"Mulberry" corpuscle of the gipsy-moth caterpillar crushed, showing nucleus. Fig. 6.—Blood corpuscle of the gipsy-moth caterpillar, showing nucleus filled with polyhedra. Fig. 7 to 9.—Blood corpuscles of the gipsy-moth caterpillar with phagocytized polyhedra. Fig. 10.—Cytoplasmic-free pathological blood corpuscles of the gipsy-moth caterpillar. Fig. 11 and 12.—Crystals found in gipsy-moth caterpillars that died of the "other cause" 128

EFFECT OF TEMPERATURE ON GERMINATION AND GROWTH OF THE COMMON POTATO-SCAB ORGANISM

PLATE XV. Fig. 1.—Germinating gonidia of the potato-scab organism, agar hanging-block, 3 hours' incubation at 35° C. Fig. 2.—Germinating gonidia of the potato-scab organism, agar hanging-block, 5 hours' incubation at 35° C. Fig. 3.—Involution forms of the potato-scab organism on synthetic agar from a 1-month-old culture, stained with carbol fuchsin. Fig. 4.—Involution forms of the potato-scab organism on synthetic agar from a 1-month-old culture, stained with carbol fuchsin 134

SEEDLING DISEASES OF SUGAR BEETS AND THEIR RELATION TO ROOT-ROT AND CROWN-ROT

Page

PLATE XVI. Isolation cultures from sugar-beet seedlings: Fig. 1.—*Rhizoctonia* sp. Fig. 2.—*Pythium debaryanum*..... 168

PLATE XVII. *Phoma betae:* Fig. 1.—Isolation culture from sugar-beet seedling. Fig. 2.—Fruiting culture on string-bean agar..... 168

PLATE XVIII. Fig. 1.—Half-grown sugar beets showing crown-rot caused by *Phoma betae*. Fig. 2.—Sugar beet showing seedling injury caused by *Phoma betae*..... 168

PLATE XIX. Mother beet showing storage decay caused by *Phoma betae*..... 168

PLATE XX. *Rhizoctonia* sp.: Root-rot of sugar beet. Fig. 1.—Result of artificial inoculation, control beet in center. Fig. 2.—Result of natural field infection..... 168

PLATE XXI. Fig. 1.—Sugar beet showing field-rot caused by *Rhizoctonia* sp. Fig. 2.—Sugar beet showing artificial infection with *Rhizoctonia* sp. on the petiole..... 168

PLATE XXII. Results of artificial inoculation with *Rhizoctonia* sp.: Fig. 1.—Sugar beet, photographed from above, showing original crown destroyed, and new leaves developing from the sides. Fig. 2.—Section of sugar beet showing character of Rhizoctonia injury..... 168

PLATE XXIII. Fig. 1.—Sugar beet showing large sclerotium (one-half inch) resulting from artificial inoculation with Rhizoctonia. Fig. 2.—Half-grown sugar beet showing injury to feeding roots due to an undescribed parasite..... 168

PLATE XXIV. Fig. 1.—Sugar beet showing damping-off due to an undescribed parasite; control pot at right. Fig. 2.—Radish showing black-root caused by the same fungus..... 168

PLATE XXV. Fig. 1.—Field in which Rhizopus rot developed. Fig. 2.—Typical beets from the field shown in figure 1..... 168

PLATE XXVI. Sugar beet showing alkali injury..... 168

PHOMA BETAE ON THE LEAVES OF THE SUGAR BEET

PLATE XXVII. An old leaf of a sugar-beet plant showing typical spots of *Phoma betae*..... 178

RELATION BETWEEN PUCCINIA GRAMINIS AND PLANTS HIGHLY RESISTANT TO ITS ATTACK

PLATE XXVIII. Fig. 1.—Oats inoculated with *Puccinia graminis* from *Dactylis glomerata* after three generations on oats. Fig. 2.—Same as figure 1, seven days after inoculation. Fig. 3.—Oats inoculated with *P. graminis hordei*, four days after inoculation. Fig. 4.—Same as figure 3. Infection thread growing over cell and destroying chloroplasts. Fig. 5.—Oats inoculated with *P. graminis tritici* four days after inoculation. Fig. 6.—Oats inoculated with *P. graminis tritici*, 48 hours after inoculation..... 200

ANTAGONISM BETWEEN ANIONS AS AFFECTING BARLEY YIELDS ON A CLAY-ADOBE SOIL

PLATE XXIX. Barley plants showing growth as affected by various salts in clay-adobe soil: Fig. 1.—*A*, *B*, Growth with 0.2 per cent of sodium chlorid alone. *C*, *D*, Growth with 0.2 per cent of sodium chlorid and 0.2 per cent of sodium carbonate. *E*, Growth with 0.2 per cent of sodium carbonate alone. Fig. 2.—*A*, *B*, Growth with 0.2 per cent of sodium chlorid alone. *C*, *D*, Growth with 0.2 per cent of sodium chlorid and 0.5 per cent of sodium sulphate. *E*, *F*, Growth with 0.2 per cent of sodium sulphate alone.... 218

A New Wheat Thrips

Page

PLATE XXX. Fig. 1.—*Prosopothrips cognatus:* Egg. Fig. 2.—*Prosopothrips cognatus:* Larva. Fig. 3.—*Prosopothrips cognatus:* Adult. Fig. 4.—Wheat leaves showing injury by *Prosopothrips cognatus* 224

Cytological Studies of Azotobacter Chroococcum

PLATE XXXI. *Azotobacter chroococcum:* Fig. 1.—Vital-stained preparation 37 days old. Fig. 2.—An 18-hour-old culture stained by the Guignard stain, showing strongly dyed protoplasmic granules. Fig. 3.—A 65-hour-old culture stained by the Guignard method. Fig. 4.—A 9-day-old culture stained by the Guignard method. Fig. 5.—A 65-hour-old culture stained progressively by the Heidenhain method, showing some empty sheaths of the peculiar zooglea masses detected by Beijerinck and Krzemieniewsky. Fig. 6.—An 18-hour-old culture on mannit agar, showing the life cycle of the organism. Fig. 7.—An 18-hour-old culture on mannit agar, showing the life cycle of the organism. Fig. 8 and 8a.—Cells drawn from an 18-hour-old culture on mannit agar 240

PLATE XXXII. *Azotobacter chroococcum:* Cells drawn at random from a 65-hour-old culture on mannit agar 240

PLATE XXXIII. *Azotobacter chroococcum:* Fig. 1.—Photomicrograph of a 65-hour-old culture stained by the Guignard method. Fig. 2, 3.—Photomicrograph of a 65-hour-old culture stained by the Heidenhain method. Fig. 4.—Photomicrograph of a 2-day-old culture stained with methylene blue 240

A New Leaf and Twig Disease of Picea Engelmanni

PLATE XXXIV. Fig. 1.—*A, Neopeckia coulteri,* ascus with mature spores; *B, Herpotrichia nigra,* ascus with mature spores; *C, Herpotrichia quinqueseptata,* ascus with mature spores. Fig. 2.—Branch of *Picea engelmanni* infected with *Herpotrichia quinqueseptata* 254

Some Sugar-Cane Root-Boring Weevils of the West Indies

PLATE XXXV. Varieties of the sugar-cane root borer (*Diaprepes spengleri*): Fig. 1.—Variety *marginatus,* female from St. Croix. Fig. 2.—Variety *comma,* male from Porto Rico. Fig. 3.—Variety *spengleri,* male from Porto Rico. 264

PLATE XXXVI. Fig. 1.—*Diaprepes spengleri,* variety *abbreviatus,* female from Porto Rico. Fig. 2.—*Diaprepes famelicus,* male from St. Kitts. Fig. 3.—*Diaprepes spengleri denudatus,* new variety, male from Guadeloupe. 264

PLATE XXXVII. *Diaprepes spengleri,* variety *festivus:* Fig. 1.—Female from Barbados. Fig. 2—Larva from Barbados 264

PLATE XXXVIII. Fig. 1.—*Diaprepes spengleri,* variety *festivus: A,* Face of larva; *B,* maxilla of larva; *C,* thoracic spiracle of larva; *D,* third abdominal spiracle of larva; *E,* last abdominal segments, ventral view; *F,* egg. Fig. 2.—*Diaprepes spengleri,* variety *spengleri: A,* Pupa, ventral view; *B,* mouth parts of pupa; *C,* mesonotum, metanotum, and first abdominal segment; *D,* ventral view of part of the seventh, and the eighth, ninth, and tenth segments; *E,* dorsal view of seventh, eighth, and ninth segments 264

A Contribution to the Life History of Spongospora Subterranea

PLATE XXXIX. *Spongospora subterranea:* Fig. 1.—A small portion of a spore ball, showing the manner in which the spores germinate. Fig. 2.—A portion of a spore ball and a small colony of amœbæ that have been set free by

Page

the disintegration of the spore walls. Fig. 3.—A semidiagrammatic drawing of a section through a very young sorus, showing the infecting plasmodium as it pushes down between the cells. Fig. 4.—An infecting plasmodium. Fig. 5.—A potato cell becoming infected by a plasmodium of *S. subterranea.* Fig. 6.—A plasmodium closely applied to the host nucleus. Fig. 7.—A small portion of a plasmodium. Fig. 8.—Portion of a plasmodium within an infected cell, showing the dense cytoplasm around the nuclei and the clearer region between them. Fig. 9.—A plasmodium pushing down between mature cells and causing secondary infection 278

PLATE XL. *Spongospora subterranea:* Vertical section through a very young sorus, showing the plasmodium as it pushes down between the cells 278

PLATE XLI. *Spongospora subterranea:* A vertical section through the edge of a young sorus, showing the intercellular spaces beneath the raised epidermis. 278

PLATE XLII. *Spongospora subterranea:* Vertical section through the edge of a young sorus, showing the plasmodia in the potato cells and the intercellular spaces above which were previously occupied by the infecting plasmodium .. 278

PLATE XLIII. *Spongospora subterranea:* Fig. 1.—A vertical section through a sorus soon after it has broken through the epidermis. Fig. 2.—A living plasmodium obtained from a culture of germinating spore balls 278

RHEOSPORANGIUM APHANIDERMATUM, A NEW GENUS AND SPECIES OF FUNGUS PARASITIC ON SUGAR BEETS AND RADISHES

PLATE XLIV. *Rheosporangium aphanidermatum:* Fig. 1.—Cleavage of the sporangium into zoospores within the wall of the presporangium. Fig. 2, 3, 4, 5, 8, 9, 11.—Nuclear divisions in the mycelium. Fig. 6.—Portion of presporangium showing rupture at tip and the initial stage of sporangium egress. Fig. 7.—Maturing presporangium. Fig. 10.—Later stage of sporangium egress from a branch of the presporangium. Fig. 12.—Vegetative mycelium; living. Fig. 13.—Section of nearly mature presporangium, showing development of large vacuoles 292

PLATE XLV. *Rheosporangium aphanidermatum:* Fig. 1, 2, 3, 4, 5.—Sections of sporangia showing various stages of cleavage into zoospores. Figure 3 shows mitochondria and, at the periphery, fragments of cilia. Fig. 6.—Segment of mycelium showing accumulation of cytoplasm characteristic of old aquatic cultures; living material. Fig. 7.—Oospore within the old oogonial wall, antheridia wall attached. Fig. 8.—Young oogonium and antheridium not yet cut off from the parent hyphæ 292

PLATE XLVI. *Rheosporangium aphanidermatum:* Fig. 1.—Section of presporangium showing nuclei and mitochondria. Fig. 2.—Section of zoospore showing mitochondria. Fig. 3.—Advanced stage of zoospore germination. Fig. 4.—Section of zoospore showing position of central vacuole and nucleus. Fig. 5.—Stages in the preparation of the fused nucleus of the oospore for division. Fig. 6.—Zoospore showing position of sinus in side. Fig. 7.—Section through zoospore showing blepharoplast and sinus. Fig. 8.—Mycelium showing nucleus and mitochondria. Fig. 9, 10.—Sections of zoospores showing blepharoplast and attachment of cilia. Fig. 11.—Zoospore showing orientation of the various structures. Fig. 12.—Maturing oospore showing fused nucleus, large central food body, and the wall, which is unusually deeply contoured. Fig. 13, 14, 15, 16, 17.—Stages in zoospore germination. Fig. 18.—Section of maturing oospore. Fig. 19, 20.—Maturing oospores showing usual type of wall and the fused nucleus in preparation for division 292

Page

PLATE XLVII. *Rheosporangium aphanidermatum:* Fig. 1.—Fertilized egg showing the two functional nuclei nearing juxtaposition. Fig. 2.—Fertilization taking place before the central vacuole of the egg has entirely disappeared. Fig. 3.—Maturing oospore showing the large central food body and the fused nucleus with two polar nucleoli. Fig. 4.—Oospore after the second nuclear division. Fig. 5.—Fertilization: Cytoplasm and functional nucleus passing from antheridium to oosphere. Fig. 6.—Fertilization occurring before degeneration of the supernumerary nuclei. Fig. 7.—First division of the fused nucleus in the oospore 292

PLATE XLVIII. *Rheosporangium aphanidermatum:* Fig. 1.—Section of presporangium showing intermediate stage of vacuolization. Fig. 2, 3.—Developing oogonia and antheridia. Fig. 4.—Oospore after nuclear fusion showing accumulation of food material at the center. Fig. 5.—Fertilized egg showing functional nuclei within the deeper stained central portion. Fig. 6.—Fertilized egg showing functional nuclei in juxtaposition within central mass. Fig. 7.—Fertilized egg showing nucleus after fusion within the deeper stained central portion and position of decolorized food bodies. Fig. 8.—Typical fertilization: Functional egg nucleus in deeply staining center of oosphere; others degenerating at the periphery. Fig. 9.—Young oogonium and antheridium showing the central vacuole and the peripheral arrangement of the nuclei. Fig. 10.—Fertilized egg: Oospore wall formed but not thickened, functional nuclei in juxtaposition within central mass, and food bodies in surrounding cytoplasm 292

HEREDITY OF COLOR IN PHLOX DRUMMONDII

PLATE C (colored). *Phlox drummondii:* Fig. ♀.—Seed parent, Eclipse variety. Fig. ♂.—Pollen parent, Carnea variety. Fig. F_1.—First-generation hybrid between Eclipse and Carnea. Fig. A to M.—Second-generation hybrids between Eclipse and Carnea 302

PLATE D (colored). *Phlox drummondii:* Fig. ♀.—Seed parent, Coccinea variety. Fig. ♂.—Pollen parent, Carnea variety. Fig. F_1.—First-generation hybrid between Coccinea and Carnea. Fig. A to G.—Second-generation hybrids between Coccinea and Carnea 302

PLATE E (colored). *Phlox drummondii:* Fig. ♀.—Seed parent, Large Yellow variety. Fig. ♂.—Pollen parent, Carnea variety. Fig. F_1.—First-generation hybrid between Large Yellow and Carnea. Fig. A to H.—Second-generation hybrids between Large Yellow and Carnea 302

ASPARAGUS-BEETLE EGG PARASITE

PLATE XLIX. *Tetrastichus asparagi:* Fig. 1.—Female adult. Fig. 2.—Egg, laid singly. Fig. 3.—Eggs, laid in pairs. Fig. 4.—Larva. Fig. 5.—Pupa, ventral view. Fig. 6.—Pupa, side view showing inconspicuous wing pads. 314

ASCOCHYTA CLEMATIDINA, THE CAUSE OF STEM-ROT AND LEAF-SPOT OF CLEMATIS

PLATE L. *Clematis paniculata:* Portion of vine showing the general nature of the leaf-spot 342

PLATE LI. *Clematis paniculata:* Group of leaves enlarged to show the zonation and pycnidia of the spots 342

PLATE LII. Fig. 1.—*Clematis paniculata:* A portion of a vine 44 inches long that showed indications of wilting of the lower leaves while the distal leaves were still turgid. Fig. 2.—*Ascochyta clematidina:* Chlamydospores as formed on starch agar. Fig. 3.—*Ascochyta clematidina:* Camera-lucida drawing of spores 342

Page

PLATE LIII. Fig. 1.—*Clematis jackmanni:* A vine free from leaf-spot that has been girdled by *Ascochyta clematidina* in the region of the previous year's stub *a*. Fig. 2.—*Clematis jackmanni:* Plant from which the diseased stub *a* was cut away without removing the discolored tissue..... 342

PLATE LIV. Fig. 1.—*Ascochyta clematidina:* Photomicrograph of a pycnidium from stained section of a leaf of *Clematis paniculata*. Fig. 2.—*Ascochyta clematidina:* Culture growing on agar to which Ivory soap at the rate of 1 pound to 15 gallons of water was added, showing the oily film about the margin of the culture in which the crystals of stearic acid are found..... 342

WALLROTHIELLA ARCEUTHOBII

PLATE LV. Fig. 1.—*Razoumofskya douglasii* on *Pseudotsuga taxifolia*, infected with *Wallrothiella arceuthobii*. Fig. 2.—*R. douglasii*, var. *abietina*, on *Abies grandis*, infected with *W. arceuthobii*. Fig. 3.—*R. douglasii*, var. *abietina*, on *Abies lasiocarpa*, infected with *W. arceuthobii*. Fig. 4.—*R. douglasii*, var. *microcarpa*, on *Picea engelmanni*, infected with *W. arceuthobii*. Fig. 5.—Left and right figures showing infection of *R. americana* with *W. arceuthobii* by infected plants of *R. douglasii*. The middle figure shows infection of *R. americana* by spraying upon the plants a mixture containing spores of *W. arceuthobii*..... 378

PLATE LVI. Fig. 1.—Enlargement of the normal fruits of *Razoumofskya americana* shown in Plate LV, figure 5. Fig. 2.—Enlargement of the diseased fruits of *R. americana* infected with *Wallrothiella arceuthobii* shown in Plate LV, figure 5..... 378

TENSILE STRENGTH AND ELASTICITY OF WOOL

PLATE LVII. Fig. 1.—Diagrammatic drawing of the fiber-testing machine of the Philadelphia Textile School. "*J*, Jaws with screw clamps for holding the fiber; the lower jaw may be raised or lowered; *R*, sliding rod working on a rack and pinion; this takes the place of weights; *G*, wheel graduated on its face in decigrams, moving on the same axis as the pinion for sliding the weight; *T*, thumbscrew for turning the small shaft working the pinion at *P*; *W*, counterbalancing weight for regulating the zero point of the machine; *S*, scale for reading the sketch of the fiber." (From Matthews's The Textile Fibres.) Fig. 2.—Fiber-testing machine removed from its case. Fig. 3.—Diagram showing the arrangement of the wool-testing apparatus at the Montana Agricultural Experiment Station..... 390

INFLUENCE OF HYBRIDIZATION AND CROSS-POLLINATION ON THE WATER REQUIREMENT OF PLANTS

PLATE LVIII. First-generation hybrids and parents used in 1912 experiments. Fig. 1.—Laguna corn, grown July 2 to September 26, 1912. Fig. 2.—Esperanza corn, grown June 12 to September 26, 1912. Fig. 3.—China corn, grown June 12 to September 26, 1912. Fig. 4.—Hybrid China× Laguna corn, grown June 12 to September 26, 1912. Fig. 5.—Hybrid China×Esperanza corn, grown June 12 to September 26, 1912..... 402

FURTHER STUDIES OF THE EMBRYOLOGY OF TOXOPTERA GRAMINUM

PLATE LIX. *Toxoptera graminum:* Fig. 1-3.—Sagittal sections. Embryo starting revolution. Fig. 4-6.—Sagittal sections. Embryo making revolution. 404

PLATE LX. *Toxoptera graminum:* Fig. 1-3.—Sagittal sections. Revolution is almost complete and shows fate of the polar organ, *p. o.* Fig. 4-6.—Sagittal sections. *d. o.*, Dorsal organ..... 404

PRICKLY-PEARS AS A FEED FOR DAIRY COWS

Page

PLATE F (colored). *Opuntia cyanella*, one of the principal species of prickly-pear used in these experiments. Fig. 1.—Mature joint. Fig. 2.—A flower bud. Fig. 3.—Young joint showing rudimentary leaves. Fig. 4.—Flower. Fig. 5.—A fruit 450

PLATE LXI. Fig. 1.—Singeing prickly-pear with a gasoline torch. Fig. 2.—Cutting prickly-pear with a hoe, the blade of which is bent so as to be in line with the handle 450

PLATE LXII. Fig. 1.—Loading prickly-pear on a wagon. Fig. 2.—Type of cows used 450

A NASTURTIUM WILT CAUSED BY BACTERIUM SOLANACEARUM

PLATE LXIII. Bacterially wilted nasturtium plant from Baltimore, Md 458

PLATE LXIV. Nasturtium plants four days after inoculation by needle pricks on the stem, using a pure culture of the bacteria cultivated from a plant infected like that shown in Plate LXIII 458

PLATE LXV. Fig. 1.—Nasturtium plant (tall variety) 13 days after inoculation with *Bacterium solanacearum* from Creedmore (N. C.) tobacco, showing wilt of the foliage and development of roots near needle pricks. Fig. 2.—Stem of a nasturtium plant inoculated with *Bacterium solanacearum* from tobacco, showing dark sunken stripe following line of infected bundle 458

PLATE LXVI. Fig. 1.—Young tomato plants six days after inoculation by needle pricks with the nasturtium organism, *Bacterium solanacearum*. Fig. 2.—Normal nasturtium stem enlarged to show uniform (unstriped) appearance. Fig. 3.—A nasturtium stem inoculated with *Bacterium solanacearum*, showing striping due to bacterial invasion of the bundles 458

TEXT FIGURES

WILT OF GIPSY-MOTH CATERPILLARS

FIG. 1. Drawing of polyhedral bodies as seen in smears of "wilted" caterpillars. 105

2. Curve showing the mortality among 20 gipsy-moth caterpillars fed with the wilt virus after filtration through the Berkefeld filter 118

3. Curve showing the mortality among the 20 control gipsy-moth caterpillars 119

4. Curve showing the mortality among 20 gipsy-moth caterpillars fed with unfiltered wilt virus 120

5. Curve showing the mortality among the 15 control gipsy-moth caterpillars 120

6. Curve showing the mortality among 15 control second-stage and third-stage gipsy-moth caterpillars 121

7. Curve showing the mortality among 26 control fourth-stage gipsy-moth caterpillars from Providence, R. I 121

8. Curve showing the mortality among 8 control fourth-stage gipsy-moth caterpillars from Providence, R. I 122

9. Curve showing the mortality among 16 control fifth-stage gipsy-moth caterpillars 122

10. Curve showing the mortality among 19 control fifth-stage gipsy-moth caterpillars 123

11. Curve showing the mortality among 50 gipsy-moth caterpillars fed with wilt virus after filtration through the Berkefeld filter 123

12. Curve showing the mortality among 25 gipsy-moth caterpillars fed with unfiltered wilt virus 124

Page

FIG. 13. Curve showing the mortality among 25 control gipsy-moth caterpillars. 124
14. Curve showing the mortality among 40 gipsy-moth caterpillars fed with wilt virus after filtration through Berkefeld filter..... 124
15. Curve showing the mortality among 40 gipsy-moth caterpillars fed with unfiltered wilt virus..... 125
16. Curve showing the mortality among 20 control gipsy-moth caterpillars. 125
17. Curve showing the mortality among 50 gipsy-moth caterpillars under conditions approximating those in the field..... 125

EFFECT OF TEMPERATURE ON GERMINATION AND GROWTH OF THE COMMON POTATO-SCAB ORGANISM

FIG. 1. Chart showing the relation of temperature to time of germination..... 130

NOTES ON THE HYDROCYANIC-ACID CONTENT OF SORGHUM

FIG. 1. Curve showing the effect of available nitrogen on the hydrocyanic-acid content of sorghum..... 180
2. Curve showing the distribution of hydrocyanic acid in sorghum..... 183

EFFECT ON SOIL MOISTURE OF CHANGES IN THE SURFACE TENSION OF THE SOIL SOLUTION BROUGHT ABOUT BY THE ADDITION OF SOLUBLE SALTS

FIG. 1. Curve showing the differences in the moisture content of treated and check sandy-loam soils..... 189
2. Curve showing the differences in the moisture content of treated and check clay-loam soils..... 190

METHODS OF BACTERIAL ANALYSES OF AIR

FIG. 1. Standard aeroscope..... 347
2. Modified standard aeroscope..... 347
3. Rettger's aeroscope..... 348

TENSILE STRENGTH AND ELASTICITY OF WOOL

FIG. 1. Curve showing the regularity of stretch and the abrupt break of merino wool after the elastic limit is passed..... 382
2. Curve showing Young's modulus of elasticity of merino wool at different stresses..... 383
3. Diagram for plotting curves by means of which the percentage of accuracy of the tensile strength of wool when comparing two sets of observations may be exactly calculated..... 386
4. Curve of ordinary probability. The abscissæ are taken as a variation in strength of a given fiber from the mean strength of all the fibers and the ordinates are proportional to the probability that such a fiber exists..... 387

INFLUENCE OF HYBRIDIZATION AND CROSS-POLLINATION ON THE WATER REQUIREMENT OF PLANTS

FIG. 1. Graph showing relation between the parental divergence $\left(\frac{a}{b}\right)$ and the hybrid divergence from the parental mean $\left(\frac{2c}{a+b}\right)$, where a=water requirement of less efficient parent; b=water requirement of more efficient parent; c=water requirement of hybrid..... 397

PRICKLY-PEARS AS A FEED FOR DAIRY COWS

Page

FIG. 1. Effect of northers upon yield of milk by cows fed with different rations.. 429

A NASTURTIUM WILT CAUSED BY BACTERIUM SOLANACEARUM

FIG. 1. Section of nasturtium leaf four days after spraying with suspension of *Bacterium solanacearum* 454

2. Cross section of a vein of nasturtium leaf showing vascular infection nine days after spraying with suspension of *Bacterium solanacearum*.. 454

3. Cross section of stem of one of the infected nasturtiums from Baltimore, Md., showing the bacterial invasion of a bundle with the beginning of bacterial cavities..... 455

TYLENCHUS SIMILIS, THE CAUSE OF A ROOT DISEASE OF SUGAR CANE AND BANANA

FIG. 1. *Tylenchus similis:* Nearly adult female. *a*, Lip region; *b*, spear guide; *c*, 3-bulbed base of spear; *d*, ampulla, salivary gland; *e*, œsophageal lumen; *f*, œsophagus; *g*, median bulb; *h*, nerve cells; *i*, nerve ring; *j*, excretory pore; *k*, initial intestinal cells; *l*, anterior salivary gland; *m*, *m*, end of ovary; *n*, ovum; *o*, renette duct; *p*, posterior salivary gland; *q*, fat granule, intestine; *r*, renette cell (?); *s*, terminus; *t*, caudal pore; *u*, vulva; *v*, anus; *w*, crenate cuticle; *x*, *x*, spermatozoa ... 565

2. *Tylenchus similis:* Male. *a*, Lip region; *c*, base of the spear; *e*, œsophageal lumen; *f*, œsophagus; *g*, vestige of bulb; *h*, nerve cell; *i*, nerve ring; *j*, excretory pore; *l*, a nerve cell; *m*, end of testis; *q*, fat granule of intestine; *s*, terminus; *t*, bursal papilla; *v*, accessory piece; *x*, spermatozoa; *y*, left spiculum; *z*, bursa..... 567